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(54) Apparatus and process for moulding multi-coloured plastic shells.

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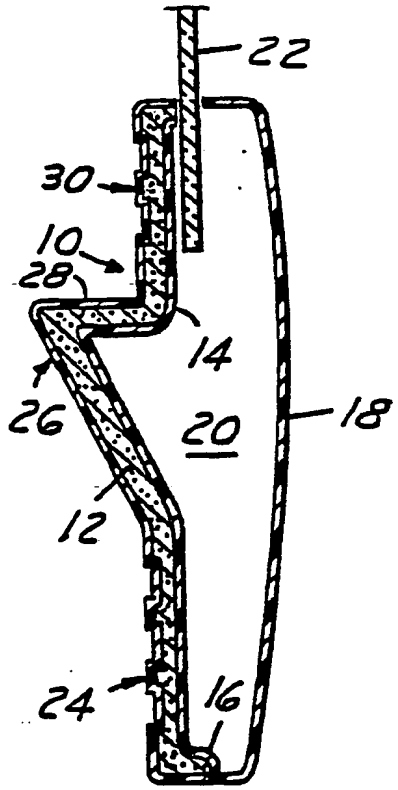
FIG.1



EP 0 367 636 A2

APPARATUS AND PROCESS FOR MOULDING MULTI-COLOURED PLASTIC SHELLS

This invention pertains to an improved plastic shell and a method and apparatus for making such articles especially suitable for use in automobile trim components such as interior door or instrument panels and more particularly to multi-tone plastic shells and method and apparatus for processing plastic powder to form such articles to have a plurality of tone colours.

The automotive industry has turned to the use of interior trim components such as door panels comprising a polyvinyl chloride shell. See, for example, the trim components disclosed in U.S. Pat. No. 3,123,403. The acceptance of such components has been primarily due to this type of construction accommodating a wide latitude in styling and colour, and grain effects which are most desired particularly in the interior design of automobiles.

The current state of the art includes a preformed grained vinyl shell made from dry thermoplastic powder particles which are applied to a heated shell mould from a powder box to form a continuous monochromatic one-piece shell.

In order to enhance the interior decor of an automobile, interior door panels and other parts have been prepared which include two separate plastic shell sections.

The use of multi-colour plastic is also known in the manufacturing of coloured filaments. Such manufacture includes use of a compartmented spinning head for making two-coloured yard as disclosed in U.S. Pat. No. 3,049,397 issued August 14 1962 for Process of making Space-Dyed Yarn.

U.S. Pat. No. 3,028,283 issued April 3 1962 discloses a golf grip of multi-colour strips with a separating bead simulating a paint stripe.

Apparatus and method for multiple coloured thermoplastic floor materials are set forth in U.S. Pat. No. 3,383,442 issued May 14 1986.

U.S. Pat. 4,562,025 issued December 31 1985, with a common assignee to the present application, covers a Mould Method and Apparatus for Multi-Colour Plastic Shells in which shell segments have their edges bonded at a common break-line.

A general object of the invention is to provide an improved integral vinyl skin shell which contains sections and/or strips having a plurality of different colour tones, and suitable for use as an interior panel component of an automobile.

Another object of the invention is to provide an improved process for forming such a multi-coloured integral vinyl skin shell.

A further object of the invention is to provide an improved mould and powder box apparatus for forming such a multi-coloured integral vinyl skin shell.

According to this invention we propose a heated mould and a powder box apparatus connected together by suitable clamp means, wherein the mould includes a plurality of spaced tear surfaces alternating with recessed surfaces, and the powder box comprises a plurality of dams or dividers of a predetermined configuration formed therein between powder compartments for operative cooperation with the recessed surfaces of the heated mould to cause powder from the compartments to cover the tear surfaces and to overlap shell segments included in the recessed surfaces to become integrally connected thereto.

Also according to the invention we propose a process for forming a multi-coloured integral vinyl skin shell including a heated mould and dual powder box arrangement wherein the mould is formed to include alternately positioned tear surfaces and recessed surfaces such that after the first powder box supplies a layer of powder to cover all the surfaces to form a shell, the strips of shell on the tear surfaces are removed, after which the first powder box is replaced by a second powder box having a plurality of spaced dams or dividers formed therein such that the dams cooperate with the respective recessed surfaces of the mould to provide clearance therewith that permit different coloured powders in the compartments between the dams to cover the previously cleared tear surfaces and to flow past the selectively formed free ends of the dams to become integrally secured to the adjacent edge portions of the shell segments remaining in the areas of the recessed surfaces of the mould.

The dams or dividers preferably have distal ends with tapered sides formed thereon for approximately the outer two thirds of the width of each dam, and an opening therebetween into a central hollow section for recovering "contaminated" or mixed powders from two adjacent compartments.

Embodiments of the invention will now be described by way of example with reference to the accompanying drawings in which:

Fig. 1 is a schematic view of a single-piece multi-coloured panel shown with associated component parts of an automotive door panel;

Fig. 2 is a diagrammatic sectional view of a mould component;

Fig. 3 is a diagrammatic sectional view of a conventional prior art powder box sealed to the mould of Fig. 2 in the pre-release or "mould-up" position;

Fig. 4 is a diagrammatic sectional view

showing the powder box and mould of Fig. 3 in a powder-release of "mould-inverted" orientation;

Fig. 5 is an enlarged, fragmentary, diagrammatic sectional view of a powder box sealed to the mould of Fig. 2 in its pre-release of mould-up position;

Fig. 6 is an enlarged, fragmentary, diagrammatic sectional view showing the powder box and mould of Fig. 5 in a powder-release or mould-inverted orientation.

Fig. 7 is an enlarged, fragmentary, diagrammatic sectional view showing the powder box and mould returned to the mould-up position;

Figs. 8 - 11 are fragmentary enlarged diagrammatic sectional views of a portion of the mould during various operational process steps.

The following description refers by way of example to the production of plastic thin-walled shells for typical automotive parts, such as interior door panels, consoles and instrument panels.

Fig. 1 shows a typical automobile door panel application of a multi-colour, single-piece interior plastic shell 10. The shell 10, preferably made of polyvinyl chloride material, is backed by a layer of polyurethane foam 12 bonded to the shell 10 by a mould process such as in U.S. Pat. No. 3,123,403 issued March 3rd 1964 fir /automobile Arm Rest. An interior reinforcing insert 14 is connected at a joint 16 to an outer door shell 18 to form an interior space 20 for window lift mechanism (not illustrated) to raise and lower a window 22.

The shell is a one-piece plastic part with an integral lower panel 24 of a drycast plastic having a first colour, an intermediate panel 26 including an armrest segment 28 formed of the drycast plastic having a second colour, and an upper panel 30 contrasting or complementing the colour of the panels 24 and 26 or other interior components. For example, the upper panel can be red, blue, yellow or beige to contrast with or complement the interior colour of seats, headliners, crashpads and the like. The lower panel 24 can be coloured a deeper complementary tone colour of a character which has a low impact or scuff display character. The intermediate panel 26 can be a colour complimentary to the colours of lower panel 24 and upper panel 30.

Referring to Figs. 2 - 6, a powder moulding process line is schematically shown as including a selectively heated mould 32. A plurality of spaced tear surfaces 34 are formed in the mould 32, with recessed surfaces 36 located alternately therebetween and having oppositely disposed wall portions 38 and 40 interconnecting each recessed area 36 with the adjacent tear surfaces 34. A conventional powder box 42 is operated between raised and lowered positions with respect to the mould 32 by suitable handling equipment. The box 42 further includes an upper open end 44 which is configured to cover the planar extent of an opening 46 to the mould 32.

Clamp means 48 join and seal the powder charge box 42 to the mould 32 when the box is elevated to the mould-inverted position shown in Fig.4,in which the mould cavity faces downwardly.

As joined, the interior of the box 42 and the interior of the mould 32 form a closed system having a powder charge in the box.

A powder box 50 (FIG.5) the same size as the box 42, is provided with a plurality of spaced dams or dividers 52,each of a width a predetermined amount wider than the width of the respective recessed areas 36 with which they are aligned, and of a length which co-operates with the areas 36 to provide a predetermined clearance therewith. Specifically, the distal end of each dam 52 includes opposite tapered sides 54, each of which spans approximately the outer one third of the width of the dam.The middle one third of each dam consists of an opening 56 into a hollow section 58 of a predetermined depth for a purpose to be described. The taper of each side 54 is such that a greater clearance 60 exists between the side 54 and the adjacent respective wall portions 38 or 40 of the recessed area 36 than a clearance 62 at the edge 64 of each side 54 at the opening 56, for a purpose to be described.

Insofar as the production process is concerned, the powder box 42 (FIG 3) must first be used, wherein such powder box is completely open, without having any of the dams or dividers 52 included therein. As a completely open box 42, only one colour plastic powder is contained therein. After being clamped to the heated mould 32 by the clamp means 48 in the mould-up position, and then rotated 180 degrees into the mould-inverted position for a predetermined period of time, the plastic powder covers the entire tear and recessed surfaces of the mould. When rotated back to the mould-up position, the mould is removed from the powder box 42, but now includes a thin layer or shell 66, as shown in FIG. 8.

As a second step, the strips 68 are removed from the tear surfaces 34, as shown in FIG. 9, leaving the recessed areas 36 lined with shell segments 70, as shown in FIG.6.

For the next step, the powder box 50 and its associated dams 52 are clamped to the heated mould 32 in the mould-up position, with a different colour plastic powder in each compartment 72. When rotated into the mould-inverted position, the various powders fall onto the respective tear surfaces 34. As indicated in FIG.6, the respective powders flow first through the adjacent clearances 60 and then past the clearances 62, such that a portion of each colour powder rests below the

opening 56.

Upon return to the mould-up position (FIG. 7), the excess powder which does not adhere to the tear surfaces 34, along with the excess powder from the space adjacent the tapered sides 54, fall back into the bottoms of the respective compartments 72, ready to be used again in the next cycle. During the rotation into the mould-up position, the portions of the different coloured powders adjacent the opening 56 are restrained by the shallow clearances 62 and caused to fall into the respective hollow sections 58, from which the now "contaminated" mixtures can be removed in any suitable manner, such as by an automatic vacuum arrangement.

The finished multi-coloured vinyl skin shell is shown in Figure 11 as it appears after it has been removed from the mould 32 of Figure 7.

It's apparent that the vinyl skin shell integrally formed in the above described manner and removed from the mould 32 includes a plurality of different coloured sections 74, 76 and 78 between the spaced original shell segments 70, and may form the respective panels 24, 26 and 30 of the particular interior door panel shell 10 of FIG. 1.

Examples of suitable mould heating processes include mould temperature control by heated and cooled air or oil heating and cooling flow as set forth in U.S. Pat. No. 4,217,325 issued Aug. 12, 1980. Suitable thermoplastic powders include plasticised polyvinyl chlorides and related vinyl resins in dry powder form for ease of gravity flow from the powder charge boxes 42 and 50 during both fill and return steps. Typical examples of parts, plastic materials and mould processes include the following :

Examples of parts that have been made by the PVC powder moulding process include a door panel shell having a mould volume of approximately six (6) cubic feet.

PVC resin, plasticizer, stabilizer, release agents and colour pigments are combined in a high intensity mixer to produce a dry, flowable powder of each desired colour. The process is known in the industry as dry-blending.

The various compound components may be selected as to type and ratio to provide the properties required both for the finished product and for ease of processing. Physical properties will not be too dissimilar from those obtained with liquid plastisol which is also used to manufacture similar products but has an inherent weakness for forming objectionable drips and runs when mae in complex shapes.

Processing properties are such that when melting of the plastic powder occurs,densification results in exact reproduction of minute detail such as selected grain marks and/or stitches engraved in the mould surface.

Mould preheating temperature may range from 250 degree F. to 450 degree F. The thickness of the finished product is governed by the length of time that the powder is in contact with the mould, in combination with the mould temperature. Hence, if certain areas of the mould can be made to have a lower pre-heated temperature than others, it will permit moulding a thinner shell in those areas. Therefore, a very flexible range, for mould-filled time, of one second to more than ten seconds has been used.

Depending on formulation, complete melting or fusion of the PVC powder can occur when mould temperatures reach 350 degree F. to 450 degree F. After fusion, the mould is cooled to a temperature which will facilitate removal of the shell without damage.

Specifically, the process and apparatus of the present invention enable even and complete distribution of thermoplastic powder material onto mould surface to form large, long, thin-walled single-piece multi-coloured shells.

Claims

1. Mould and powder box apparatus wherein the mould includes a plurality of alternate tear surfaces and recesses with vinyl shell segments retained in the recesses and the powder box comprises a housing, spaced dams mounted in the housing providing compartments therebetween and for receiving thermoplastic powder in each compartment, with each dam being aligned with and of a length which provides a predetermined clearance with the respective aligned recesses, and a hollow section formed in the end of each dam adjacent the longitudinal central portion of each recess.

2. Apparatus according to claim 1, wherein each dam is a predetermined amount wider than the width of the respective aligned recesses.

3. Apparatus according to claim 1 or claim 2, wherein the distal end of each dam includes opposite tapered sides formed adjacent the wall portions of the respective recesses and each side spanning approximately the outer one-third of the width of the dam, with the hollow section therebetween.

4. Apparatus according to claim 3, wherein the clearance between each tapered side and the adjacent wall portion of a recess is greater than the clearance between the inner edge of each tapered side and the bottom portion of the recess.

5. A vinyl shell moulding process comprising the steps of :

a) Providing a heated mould having alternate tear surfaces and recesses formed therein :

(b) Providing a powder box containing a thermoplastic powder;

(c) Connecting the open ends of the mould and powder box together and rotating the assembly to allow the powder to fall onto and cover the tear surfaces and recesses;

(d) Rotating the assembly into a mould-up position and removing the mould from the powder box.

(e) Removing the strips of vinyl shell from the tear surfaces, leaving shell segments in the recesses;

(f) Providing a second powder box having dams formed therein such that the dams are adapted to align with and clear the respective recesses in a predetermined relationship, and the compartments between the dams are adapted to carry different coloured thermoplastic powders;

(g) Connecting the second powder box to the heated mould and rotating the assembly to allow the respective powders to fall onto the respective tear surfaces and flow into the clearances between the dams and the respective recesses;

(h) Rotating the assembly into the mould-up position, removing the second powder box, and removing the integral shell of different coloured sections from the mould.

6. A process according to claim 5, wherein each dam includes a hollow central section for receiving intermixed powders of two different colours when the assembly is rotated into the mould-up position.

7. A process according to claim 6, wherein the distal end of each dam includes opposite tapered sides formed adjacent the wall portions of the respective recesses and each side spanning approximately the outer one-third of the width of the dam, with the hollow section therebetween.

8. A process according to claim 7, wherein the clearance between each tapered side and the adjacent wall portion of a recess is greater than the clearance between the inner edge of each tapered side and the bottom portion of the recess.

FIG.1

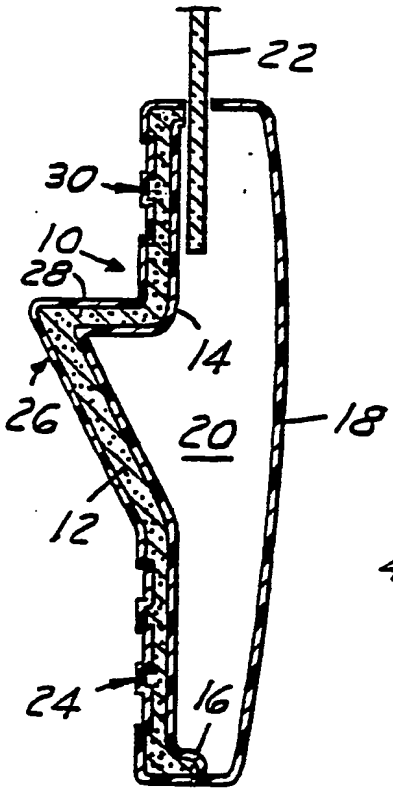


FIG.2

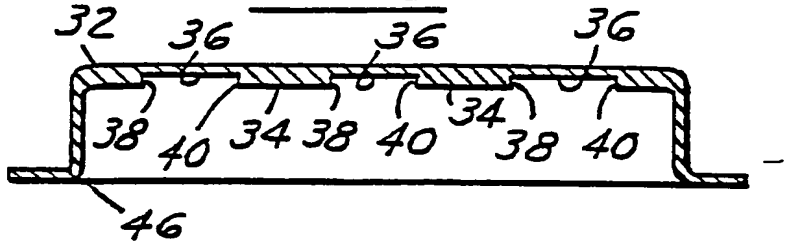


FIG.3

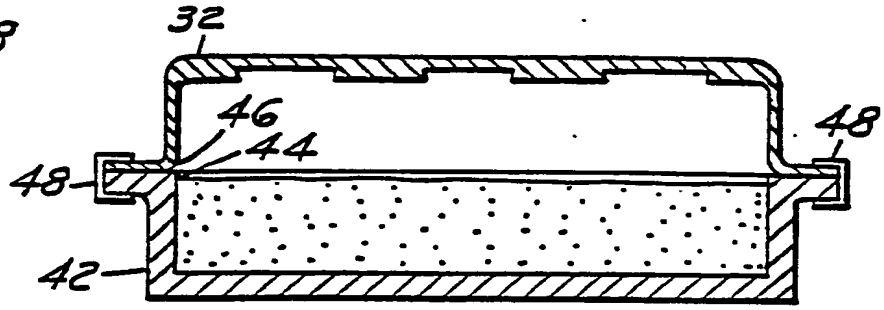


FIG.4

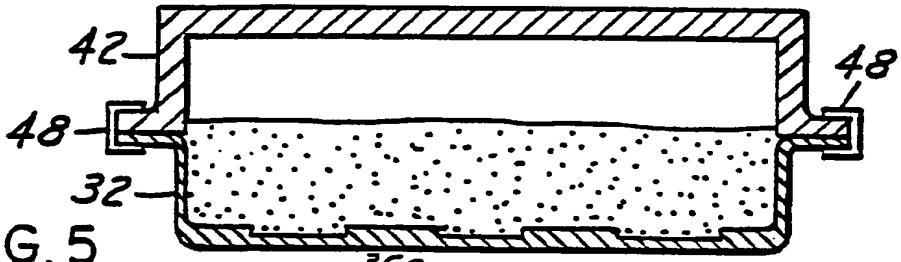


FIG.5

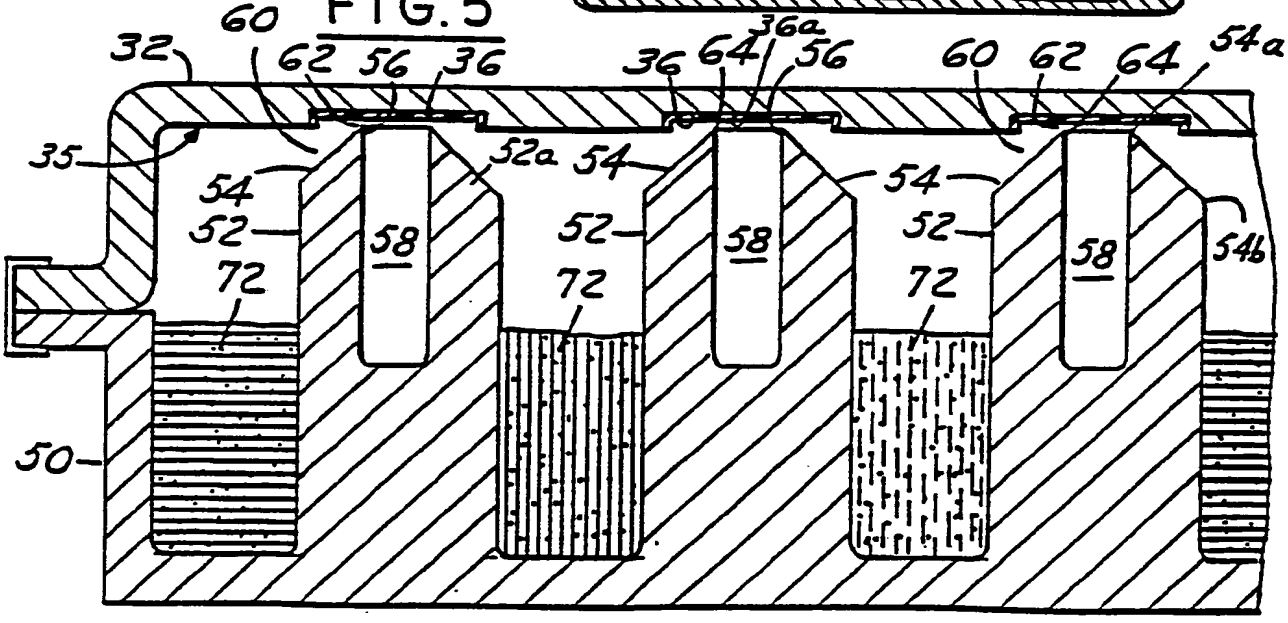


FIG.6

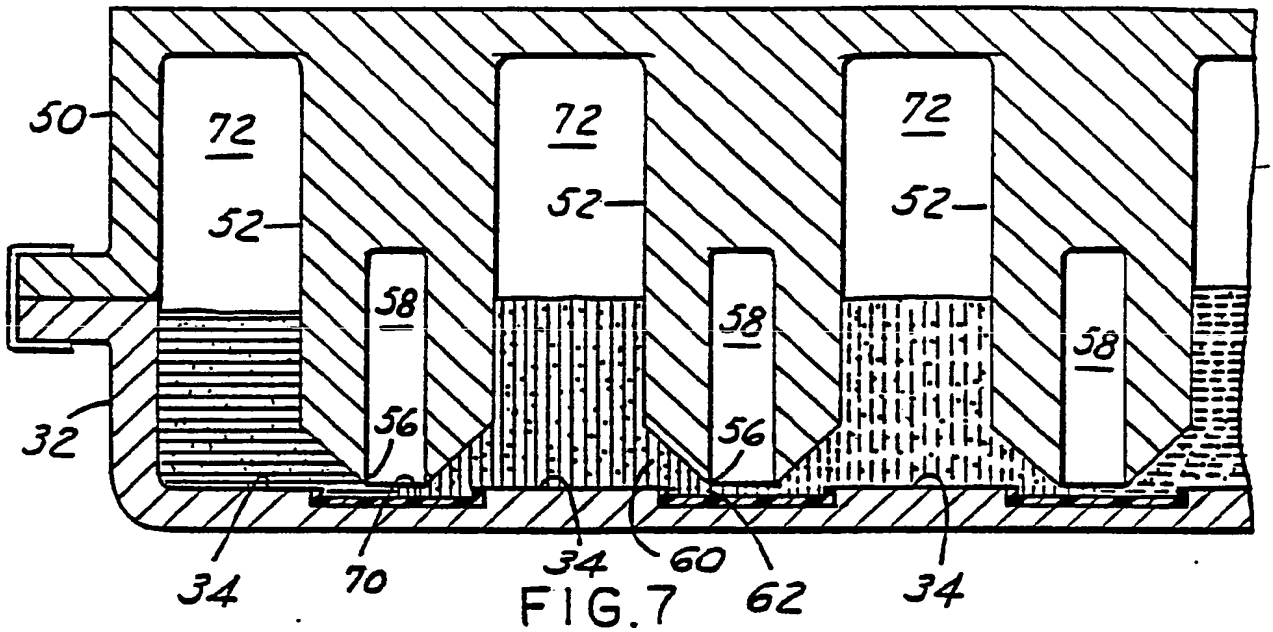


FIG.7

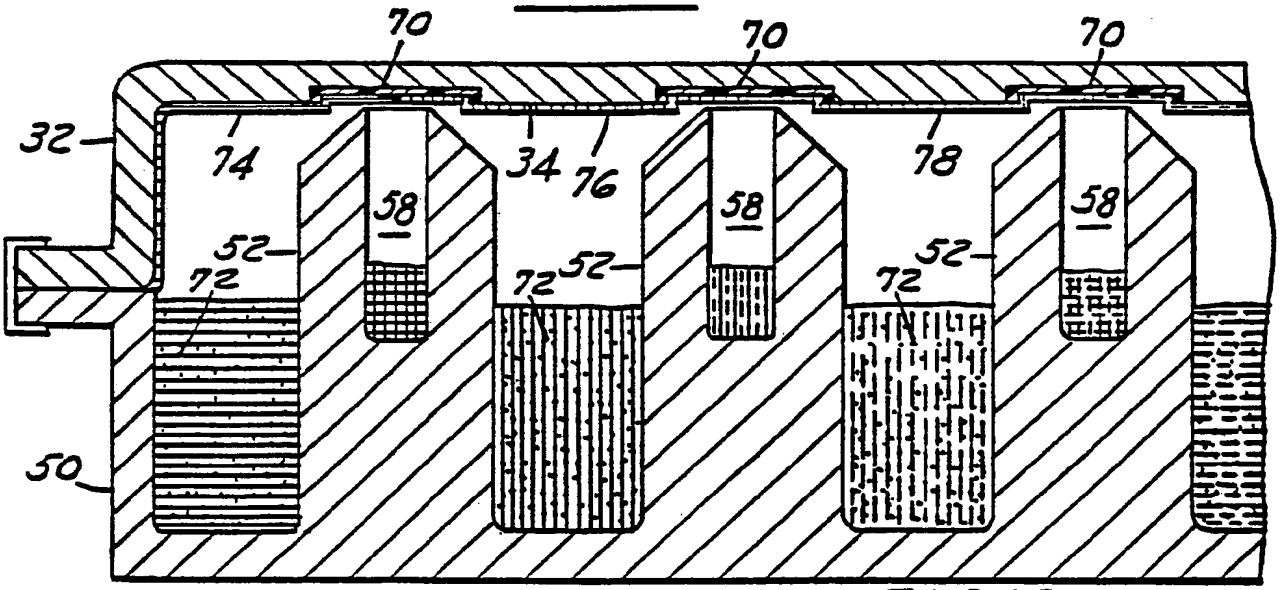


FIG.8

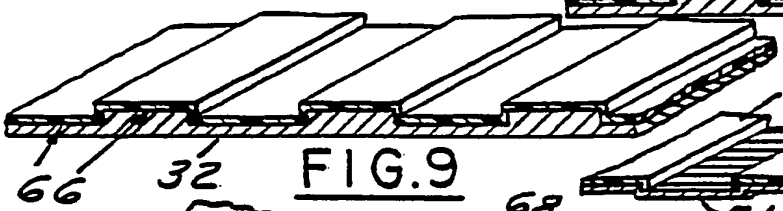


FIG.9

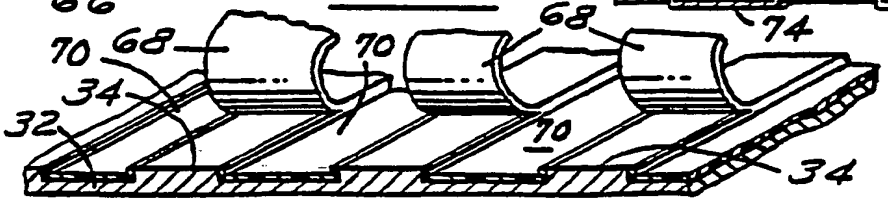


FIG.10

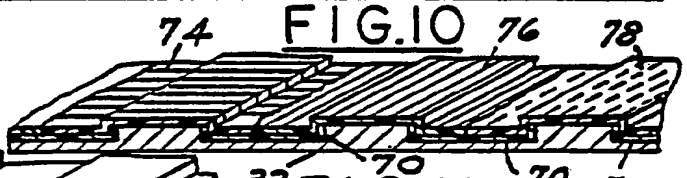


FIG.11

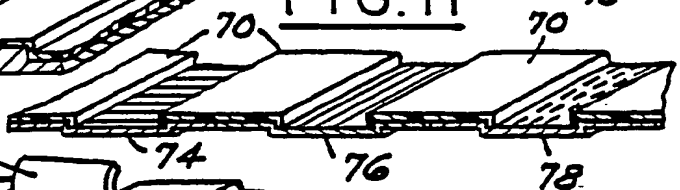


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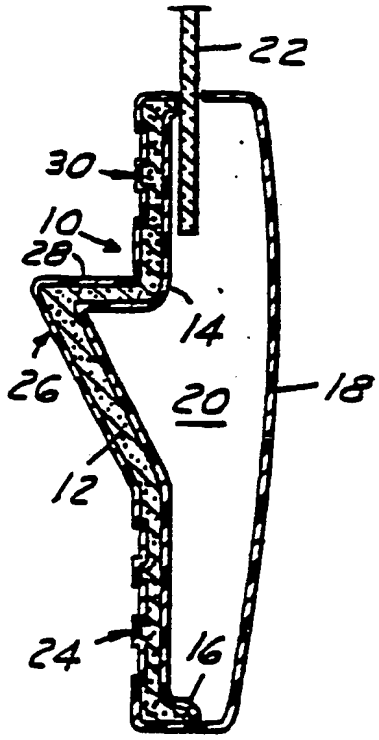
FIG.1



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EUROPEAN SEARCH REPORT

Application Number

EP 89 31 1479

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
D,A	US-A-4 562 025 (GRAY) * Abstract; claims; figures *	1,5	B 29 C 41/22
A	EP-A-0 183 344 (EX-CELL-O) * Claims; figures *	1,5	
A	PATENT ABSTRACTS OF JAPAN, vol. 11, no. 94 (M-574)[2541], 25th March 1987; & JP-A-61 246 021 (TOKAY KASEI KOGYO) 01-11-1986 * Abstract; figures *	1	
A	PATENT ABSTRACTS OF JAPAN, vol. 9, no. 11 (M-351)[1734], 18th January 1985; & JP-A-59 159 309 (INOUE EMU TEE) 08-09-1984 * Abstract; figures *	1	
A	PATENT ABSTRACTS OF JAPAN, vol. 9, no. 7 (M-350)[1730], 12th January 1985; & JP-A-59 156 710 (INOUE EMU TEE) 06-09-1984 * Abstract; figures *	1	

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

B 29 C

The present search report has been drawn up for all claims

Place of search	Date of completion of search	Examiner
The Hague	25 October 90	VOUTSADOPOULOS C.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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